Digital Computer Laboratory
Massachusetts Institute of Technology
Cambridge, Massachusetts

SUBJECT: PROJECT GRIND MEETING OF JULY 2, 1953 (Sixth Day)

To: AN/FSQ-7 Planning Group

From: A. P. Kromer, R. P. Mayer

Date: July 8, 1953

Abstract: This meeting concerned standard circuits and the action of the standards committee. Four tube types were definitely approved and it was decided that 0.1μsec pulses will be used wherever possible in the system. It was generally agreed that a Project Grind meeting should be held at least once every other week. The next meeting will be held July 15 at M.I.T. The agenda will be prepared.

Members Present:

MIT	IBM
R.L. Best	*J.V. Anderson
R.J. Callahan	M.M. Astrahan
N.L. Daggett	*T.A. Burke
R.R. Everett	*J.M. Coombs
*R.S. Fallows	R.P. Crago
A.W. Heineck	D.J. Crawford
J.F. Jacobs	N.P. Edwards
R.P. Mayer	*J.A. Goetz
K.H. Olsen	*E.H. Goldman
N.H. Taylor	H.D. Ross
C.W. Watt	*R.W. Sweetland
	*D. Thompson

This is to remind the reader that the object of the minutes of the Project Grind meetings is to put on record some of the decisions made and some of the reasons for these decisions. Any problems will be brought into the open so that decisions can be made as soon as possible. If there are any errors or omissions in the minutes, they should be called to the attention of A. P. Kromer or R. P. Mayer

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* Part time

I. Vacuum Tube Types

The Tube Committee* will write a note to Project High and Project Lincoln briefly listing the tube types that are accepted. This will be followed by a memorandum on how to use the tubes, including curves and other data. The following tube types were accepted at the Project Grind meeting: 7 Ak7, 5965, 5998, and 2D21. It was also agreed that 4X150A and 6146 tube types could be used for statistical applications, but only if the Tube Committee* first approves the use of them for each given case. Any other vacuum tubes that the designer wishes to use must first be approved by the Tube Committee*. Note: Not mentioned at the meeting was the fact that improved types which are electrically-equivalent tubes will probably be substituted as standards in place of 7 AK7, 5965, and 2D21, and that a low level amplifier (6136 or 5963) must be investigated.

II. High-Speed Flip-Flop

The high-speed flip-flop is described in Engineering Note E-543. This high-speed flip-flop has been generally accepted, but it has not been decided under which conditions cathode followers on the outputs of this flip-flop can be omitted. It is generally accepted that cathode followers must be included if 2 gate tubes are pulsed at the same time, or if any gate tube is in a different pluggable unit from the flip-flop, or if the gate tube is pulsed longer than 0.1μsec. It has been decided to provide cathode followers in all circuits until more data has been accumulated on when it is alright to omit them.

III. High-Speed Gate Tube Circuit

Two standard gate tube circuits (generally accepted) are described in the Military Reference Data Book sections 202.1 and 202.2. These gate tube circuits will always drive a 93 ohm load, but the turns ratio on the output transformer has not yet been decided. The input transformer will not be needed in some cases. It is probably sufficient to have only 1 decoupling network for a set of gate tubes on one side of a flip-flop if no more than one is pulsed at a time.

IV. Diode Circuits and Cathode Followers (CF)

Report IM #38 will soon be available and it describes some of these circuits. It is impractical to design various standard CF circuits because each case is different. It is probably true that no more than 2 diode levels should be used before a CF is inserted. D. J. Crawford should make sure that similar applications are coordinated. There should probably be a standard design for a 32 position switch, since such a circuit is used in a number of places. Semi-standard circuits can probably be used in other isolated cases, although different load resistors would have to be calculated for each case. A step by step design procedure is being prepared. In preparing the design procedure, certain desirable and undesirable combinations of diode gates and pulse gates should be listed.

* Tube Standards Subcommittee

V. Pulse Lengths

It was fairly well decided that only 0.1μsec pulses would be used in the system except for the special-length pulses used for the drum (about 1.5μsec). This standard drum pulse should also be used for driving cores if possible (it may be necessary to design a new standard circuit for allowing a gate tube to drive a core directly).

VI. Low-Speed Flip-Flop

It was decided that a low-speed flip-flop can be used only if it meets the following conditions:

(1) It must set and clear upon receiving 0.1μsec pulses.
(2) It must drive gate tubes to +10 volts on the suppressor.
(3) Gate tubes connected to it must pass 1.5μsec pulses.
(4) The rise and fall times must meet specifications (as yet undecided).
(5) It must be used in a sufficiently large number of places in the system.

It should be pointed out that the low-speed flip-flop should not be complemented with 0.1μsec pulses. If it is used in a drum address counter slightly longer pulses can be used. If it is desirable to complement it for marginal checking this can be done by alternately setting and clearing it.

VII. Cathode Ray Tubes

It is apparently true that there is little difference in intensity between an electrostatically controlled CRT and a magnetically controlled CRT if a high anode voltage is used in both cases. An all-electrostatic deflection system would take less equipment than the partly electro-magnetic system mentioned on the fourth day and so is being investigated. Such a system would also be considerably faster in positioning the spot, but it is estimated that characters would not be generated any faster (20μsec per character), resulting in only a small decrease in display-cycle time. A 2.5 KV supply would be required at each console for the deflection amplifier in the all-electrostatic system.

VIII. Miscellaneous Circuits

A capacity-loaded cathode follower with transformer coupling can probably be used to speed up rise and fall times. This circuit should be investigated.

VIII. Miscellaneous Circuits (continued)

The following types of circuits should perhaps be shelved until it is found they are needed:

DC inverter, DC level-setter, pulse standardizer, 0.5μsec pulse generator, gate generator.

The pulse standardizer could perhaps be replaced by proper design of the pulse amplifier or by making the pulse transformers standardize the pulses (if the transformer does not lose other of its desirable characteristics).

Any gate generator that is required can presumably be made by using a standard flip-flop with a standard delay line.

It was generally agreed that a 7AK7 (tetrode connected) could be used for a register driver. It was pointed out that unity gain is not required for register drivers.

It was generally agreed that a contact-operated, non-synchronous pulse generator should be developed. It was suggested that an integrator be included in the contact circuit.

It was agreed that a high-speed delay unit for delaying a 0.1μsec pulse for any specified amount up to a few μseconds should be developed.

A new circuit ("slave FF") was proposed for use in cases where there is very close timing. It can be described as a low-speed FF circuit with the "set" pulse injected by way of a transformer circuit which forces both sides of the flip-flop to the proper condition within 0.1μsec. The "clear" pulse would work in a similar way.

A single-shot multivibrator should be developed, but it must accept 0.1μsec pulses (using a pulse stretcher if necessary). It was definitely agreed that the multivibrator circuit must be designed in such a way that no matter how deteriorated it becomes it will neither "hiccup" nor run free.

A decision will have to be reached at a later time concerning the method of clearing all flip-flops in the computer. One possibility is to pulse a clear line linking all flip-flops and another possibility is to turn off the power supply on one side of the flip-flops (by way of the marginal checking circuits).

There are a number of types of circuits for controlling cores (input and output registers, character generators, etc.). It would be desirable to standardize as many of these core circuits as possible. It might be desirable to subcontract some of the development work (potting, etc.). Perhaps TPM buffers could be used if they appear to be applicable.

VIII. Miscellaneous Circuits (continued)

It was generally agreed there are more drum amplifiers than arithmetic element adders, etc., and so we should concentrate on the drum circuits as much as on the arithmetic circuits.

Any person who wishes to use any kind of a circuit should try to find it in the standards book or discuss his problem with the standards committee. He should write down specifications that he requires and submit this to the standards group for development and approval. The basic circuits subcommittee is responsible for collecting specifications from people who use the circuits. Forms are being prepared for collecting these specifications.

IX. Standards Committee *

The standards committee is preparing a standards book which will show how to use components. It will provide rule of thumb procedures as well as details on components. The basic circuits book will appear in a separate and smaller volume.

Someone at IBM Project High must start preparing purchasing specifications. These should specify necessary tests on the components but should not attempt to restrict components to a given manufacturer.

Some of the military specifications as shown in MIL-E-4158 (USAF) are not applicable and we must propose specific alternatives. For example, it was proposed that moisture and fungus treatment should not be applied to the equipment but should be applied to the shipping crates and the operating building.

The circuit design groups should take an active interest in making sure that the testing group (Jack Goetz) makes the necessary tests on components as used in proposed circuits.

An approval procedure for circuits, components, etc., is being worked out and will be explained in a memorandum. The procedure will probably be something like the following: tentative specifications will be circulated and any interested people can suggest comments and/or indicate approval. Sweetland and Watt as Chairmen of Central Standards Committee will sign the specifications when they are convinced that the proper interested people have indicated their approval. R. R. Everett will then sign the final approval for Lincoln. When tentative specifications are approved by the Standards Committee they will be issued as provisional standards, and can probably be used with confidence that they will eventually receive final approval. Any reference to military specifications will include a condensation of those specifications.

Signed: A. P. Kromer

R. P. Mayer

APK/RPM:RMB

* See Memorandum M-2213 for explanation of the organization of the Standards Committee